stuffs were placed in the terrarium. After four weeks a plug was constructed which effectively sealed both the male and the female in the burrow.

REFERENCES

SHIPWAY, B. 1951. The natural history of the Marron and other fresh water crayfishes of south-western Australia. Part 1. *W.A. Nat.*, 3 (1): 7-12. Part 2. *Ibid.*, 3 (2): 27-34.

FLOWERS ADAPTED TO MAMMAL POLLINATION

By EIGIL HOLM, Byskovsvej 4, 8751 Gedved, Denmark

ABSTRACT

Some Banksias and Dryandras which presumably are adapted for mammal-pollination are described. The inflorescences are dull-coloured (brownish, reddish, greenish and violet) and have different odours, which are strongest at night. The inflorescences are placed on or near the soil or into the shrub. The mouth of one of the presumed pollinators, the Honey-Possum *(Tarsipes spencerae)* is described.

The Honey-Possum *(Tarsipes spencerae)* is specially adapted to take its food: nectar and pollen from flowers. The teeth are inconspicuous and unable to chew anything, neither can they pick up insects (Fig. 1). The tongue is a brush and readily takes up nectar and pollen. The palate has pronounced ribbing and will probably be able to take the nectar and pollen from the brush when the tongue is moved against the palate. One pair of teeth in the front of the upper jaw apparently are adapted for cleaning the side of the tongue.

On the lower side of the tongue there is a keel, which glides between the two incisors in the front of the lower jaw. These teeth are placed, so the movements of the tongue are steered.

Also the Pygmy-Possum *(Cercartetus concinnus)* and the Dibbler *(Antechinus apicalis)* feed on nectar from flowers, but they eat insects too. They are not so specialised flower-feeders as the Honey-Possum.

The fur of mammals can easily transfer pollen from one flower to another, and there is no doubt that these mammals in fact do pollinate flowers.

As there are mammals adapted to flower-feeding and pollination, one should expect that there are flowers adapted for mammal-pollination. But no such flower has been described in the literature concerning pollination.

The mammals have been observed and photographed on Banksia flowers (M. K. Morcombe), but only on Banksias primarily adapted for

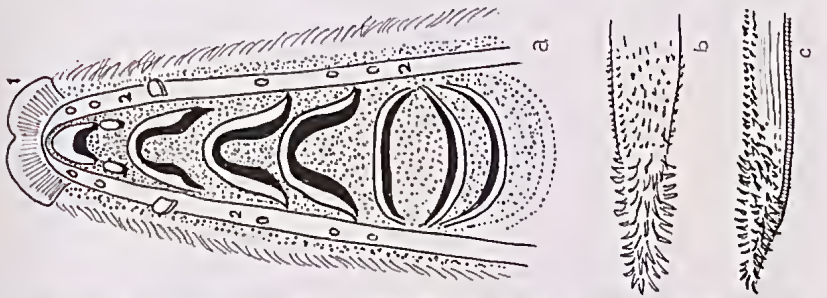

Fig. 1.—Honey-Possum *(Tarsipes spencerae)*. a. Palate, upper jaw (2) with teeth and snout (1). The ridges on the palate are very prominent. (Schematic drawing). b. Upper side of tongue. c. Tongue seen from the side. Note the keel below (vertical lines).

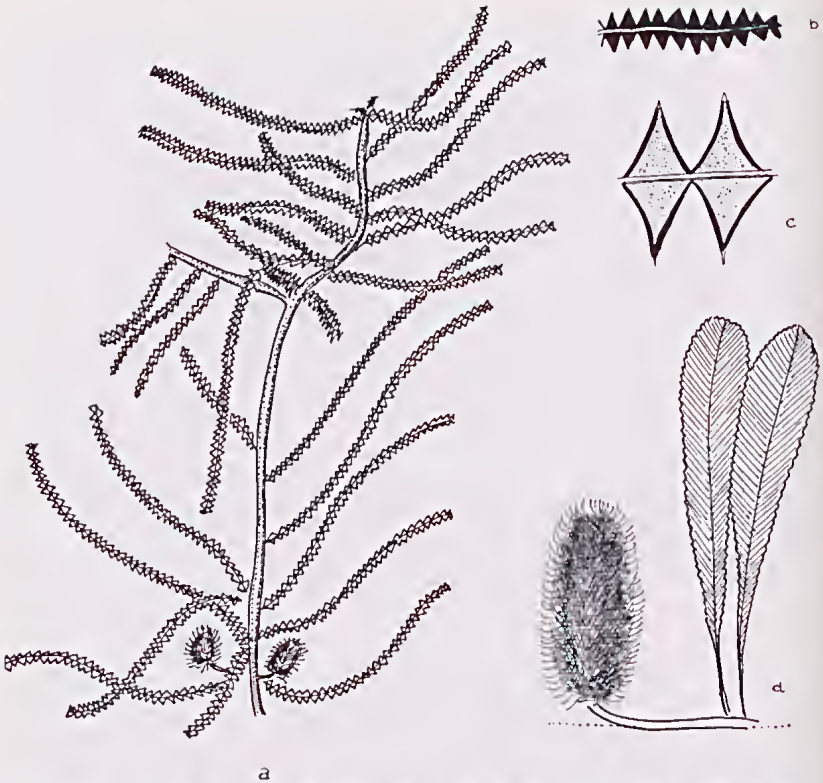

Fig. 2.—a. *Banksia dryandroides*, the spikes are found deep in the shrub. b. Part of leaf, 1x. c. Underside of the leaf with little thorns and revoluted margins. d. *Banksia petiolaris* (The soil surface is dotted.)

bird-pollination. The bird-pollinated Banksias have bright red, yellow or orange flowers in a conspicuous spike, placed on the bush or tree, so that they are readily seen. Their styles are rigid and their nectar production is often copious. They normally have no fragrance, as birds have a poor sense of smell.

During my stay in Western Australia in the spring of 1977 I looked for flowers which could be specially adapted for mammal-pollination, and I probably had the luck to find them.

On October 28 I found a specimen of *Banksia dryandroides* south of the Stirling Ranges. It was a shrub, approximately 1½ metres high (Fig. 2). I tried to take a branch, and as I did so, I saw the spikes of flowers deep inside. I tried to pick one of them, but then I discovered it was quite a difficult job. The long interlaced leaves were a hindrance for my flower-picking. A bird probably would be unable to penetrate the foliage to get at the flowers. But a mammal, coming from below and climbing the branches, would have easy access to the flowers.

In fact, the bird would scarcely be attracted to the flowers, as their colours are an inconspicuous dull yellow-green and brown. Also they are invisible from the outside. Some of the spikes are situated so deeply in the shrub that they are placed between the wilted leaves, which remain on the branches.

The leaves are constructed in a special way (Fig. 2b, c). They are

extremely long, about 20 cm, but only 1 cm broad. They bend easily in the longitudinal direction, but they are extremely stiff in the transverse direction due to revolution of the margins. The leaves have teeth, and there is a little thorn on the apex of each tooth. This arrangement causes the leaves to be entangled when someone tries to penetrate the shrub from outside.

The flowers have a stiff style. When you touch the inflorescence you experience the same feeling as when you touch a clothing brush. Mammals can climb the inflorescence without causing damage. The perianth is soft, split to the ground and contains nectar. It will afford no resistance to the snout and tongue of a mammal.

I collected the flowers at noon, and they only had a faint sweet odour. As the mammals concerned are nocturnal, I expected that the attractive odour only would be there in the night. Therefore I made a visit to a shrub at 10 p.m. some days later in Kings Park, Perth. The odour was much stronger, a litle sour. It was an odour of the type mammals often have.

In Stirling Range I observed *Dryandra mucronata*. The leaves are very similar to *Banksia dryandroides*, but are longer, about 30 cm. I have not seen the flowers, but the fruits are inside the shrub, and the flowers therefore must be there too.

Banksia candolleana is built after the same scheme.

All three plants are so similar that I suspect them to be pollinated by the same mammals.

I asked Mr Alex George, of the Western Australian Herbarium, Department of Agriculture, South Perth, if he could name other Banksias with hidden flowers. He named six species:

* *Banksia sphaerocarpa, Banksia elderana,* * *Banksia baueri, Banksia caleyi, Banksia lullfitzii* and * *Banksia nutans.*

The species marked with an * do not have interlaced leaves which prevent penetration into the shrub. I have not seen the other species.

I found three of those species in Kings Park, but none were flowering at the time. However, on my excursion I found some flowering species of another type of Banksia, which might be pollinated by mammals: *Banksia blechnifolia* and *Banksia petiolaris* (Fig. 2d). Both of them have their spikes resting on the soil besides the plant, not between the leaves. Their styles were stiff, their odour was of that type which you expect from mammals. Their odour was different and also different from the odour of *Banksia dryandroides*. And the odour was most pronounced at night. The colours of the flowers are dull; *B. blechnifolia* red-brownish and *B. petiolaris* brown. *Banksia prostrata* is of the same type.

I also observed *Banksia pilostylis*. Some of its spikes are on the outside, but most are into the shrub. The colour is dull yellow, and the odour sour, cheese-and-onion-like. I also suspect, that this species might be mammal-pollinated, but perhaps bird-pollinated, too.

What I have told until now is not a proof, that those plants are adapted for mammal-pollination. The final proof is, that you observe the mammals working on the flowers, that you see pollen in their fur, and that you see the mammals proceed to other spikes, preferably on other shrubs. Alas, I have not seen these animals alive. Birds and insects could be found on the flowers occasionally, but mammals should be the main pollinators.

I would appreciate very much if readers would help me in collecting evidence by answering some of the following questions:

Which Banksia(s) or Dryandra(s) have you observed?

Which mammals have you seen on the Banksia(s) or Dryandra(s)?

Which colour(s) have the flowers?

Which odour have the flowers by night/by day?

Did you find nectar in the flowers?

When were the flowers observed?

Have you observed birds on the Banksia with spikes on the soil?

Answers could be sent to *W.A. Naturalist*. I would be grateful, if the answer could be accompanied by a twig and some spikes from the Banksias concerned.

The answers will be used for my final publication.

Note: The description of the honey-possum is preliminary, and I am carrying on further investigations.

REFERENCE

MORCOMBE, M. K. 1968. *Australia's Western Wildflowers*. Melbourne.

FROM FIELD AND STUDY

The Oriental Cuckoo at Dampier.—The known distribution of the Oriental Cuckoo, *Cuculus saturatus*, in Western Australia has been documented by Serventy and Whittell *(Birds of Western Australia*, 1976). The only record so far known south of the Kimberley Division of this non-breeding migrant from Asia was seen in the Pilbara on March 19, 1973.

On the morning of November 28, 1977, an injured Oriental Cuckoo was found in the garden of a Dampier home. The bird was brought to me; however I could find no superficial injuries. Unfortunately the Cuckoo died later that day. Photographs of the dead bird were taken to enable positive identification to be made.

—K. D. PERRY, Dampier.

Co-operative breeding by Red-winged Wrens *(Malurus elegans).*—Four years ago when one of us reviewed the incidence of co-operative breeding in Australian birds (Rowley, *Proc. 16th Int. Ornith. Congr.)* eight species of *Malurus* had been recorded breeding co-operatively (loc. cit., p. 661).

In September, 1977 Pam Chapman found a nest of *Malurus elegans* in Jarrah forest to the south of Mundaring. On 24 September one of us photographed three individuals (2♂♂, 1♀) attending the nest which by now contained nestlings. On 25 September the two males were mist-netted, colour-banded and watched returning to the nest. This is the first record of co-operative breeding by *Malurus elegans.*

—GRAEME CHAPMAN and IAN ROWLEY, CSIRO, Division of Wildlife Research, Helena Valley, W.A.

Adult White-tailed Tropic-bird, *Phaëthon lepturus,* **at Torbay.**—Around mid-day on 14 December 1977 we saw a White-tailed Tropic-bird at close quarters at Torbay on the south coast of Western Australia.

The bird flew over us at a height of about 15 metres, moving east from the high ground and out into the bay. The differences from the Red-tailed Tropic-bird, *P. rubricauda,* were immediately noticed. The central tail feathers were white and much broader, the underwing pattern showed a large dark or black area under the primaries contrasting with the all-white underwing of the Red-tailed Tropic-bird. The bill was light-coloured and the reflection from the sand made it appear horn-coloured. The exposed parts of the feet were very dark.

We were both impressed by its smaller size and more gracile form than the Red-tailed Tropic-bird. Crested Terns nearby provided a frame-of-reference.

We are both familiar with the Red-tailed Tropic-bird in the wild and in captivity.

—C. A. NICHOLLS and T. SPENCE.